PATENT SPECIFICATION 716,109

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COMPLETE SPECIFICATION.

Improvements in, or relating to, Apparatus for Winding Paper, or other similar Flexible Strip Material, into Roll Form.

We, WALKER CROSWELLER & COMPANY LIMITED, a British Company, of Whaddon Works, Clyde Crescent, Cheltenham, Gloucestershire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention has reference to apparatus for winding flexible strip material, such as paper, photographic film and the like, into roll form.

One particular application of the invention is to apparatus for embodiment in recording instruments (such as fluid flow or pressure recording instruments) of the kind wherein a strip of paper is fed from a roll in one part of the instrument, across a viewing aperture, to another part of the instrument where it is to be rewound into its original roll form and, during its passage from the said one part to the other, is marked by a scribe which is reciprocated under the control of pressure sensitive or similar mechanism incorporated in the instrument; in an instrument of this kind, apparatus in accordance with the invention, may be installed in the said other part of the instrument for re-winding the marked strip of paper into its original roll form.

Although the invention will be described hereinafter as applied to re-winding apparatus for an instrument of the above kind, it is to be understood that the invention is not limited to this particular application as it may be applied equally well to apparatus for re-winding photographic film in roll-film cameras or to apparatus for use in any instrument, apparatus or machine wherein a driven strip of flexible material has to be wound into roll form.

The principal object of the present invention is to provide an automatic winding apparatus which is of compact dimensions, simple and robust in construction, efficient in operation, and adapted to operate over long periods without attention.

Further objects of the invention are to enable the paper or like material which is wound by the apparatus, to be unwound by hand for inspection or other purposes, and, if desired, to be re-wound again; to enable a wound roll of paper or the like to be removed bodily from the apparatus; and to ensure that the apparatus, when embodied in a recording instrument, does not restrict the amount of marked paper which is visible through the viewing aperture.

In accordance with the said invention, apparatus for winding flexible strip material into roll form comprises a cam which is fixed to a driven spindle within a cylindrical shell around which the material is to be wound, the said shell being mounted on but being rotatable relatively to the said spindle and having a longitudinal slot in its periphery to enable the leading end of the strip material to be fed into the shell and to be gripped between the internal surface of the shell and the external periphery of the cam, and resilient means being provided for holding the shell against rotation until after the said strip end has been gripped between the shell and the cam.

Preferably the resilient means comprise a resilient abutment, such as an edge of a spring loaded, pivoted plate, which is located adjacent the shell, the latter being provided at one edge of the longitudinal slot, with an external projection which impacts the said abutment to prevent rotation of the shell and locate the slot in the plane of the plate, until the end of the strip has entered

the slot and has been gripped between the cam and the shell.

The spindle may be driven by a constant speed motor through a drum, over which the material passes and by which the said material is fed at a constant speed towards the shell, and through a speed-increasing drive-transmission device which includes slip means so that, until the end of the material enters the shell slot and is gripped between the cam and the shell, the spindle is driven at a greater speed than the drum, but thereafter is driven at a speed determined by the speed at which the material is fed forwards by the drum; the provision of the slip means also enables the spindle to be held stationary or, if desired, rotated manually in the reverse direction while the rotation of the drum is continued.

In order that the invention may be more readily understood and carried into practice, reference will now be made to the accompanying drawings, wherein:—

Figure 1 is an elevation of a part of a recording instrument in which a winding apparatus, in accordance with the invention, is installed.

Figure 2 is a sectional plan of Figure 1.

Figure 3 is an elevation, on an enlarged scale, of the winding apparatus, showing a re-wound length which has just been removed therefrom.

Figure 4 is a sectional elevation, on a still larger scale, of the winding apparatus.

Figure 5 is a section along the line *a*—*a*, Figure 3, on the same scale as Figure 4.

Figure 6 is a similar view to Figure 5, showing the leading end of a length of paper being fed to the apparatus.

Figures 7—9 are plans of the apparatus showing successive initial stages in the winding of the leading end of the length of paper.

Figure 10 is a sectional plan, similar to Figure 5, showing an alternative shape of cam.

Referring to Figures 1—3 of the said drawings, 1 is a sheet metal guide which is adapted to be installed in a recording instrument by engaging the spigot 2 in a complementary socket (not shown) fixed internally of the instrument casing (not shown), and the socket 3 on a complementary spigot (not shown) also fixed internally of the said casing. The guide is thus pivotable relatively to the casing and normally, is held against pivotal movement by a spring-loaded jawed lever 4 which is adapted to engage a stud or similar anchorage (not shown) fixed internally of the said casing.

The guide is formed along its upper edge with a channel 5 and along its lower edge with a similar channel 6, the said channels being parallel to one another, with the mouths opening inwardly of the guide 1. Consequently, the edges of a paper strip 7 rolled around a spool 8 journalled between upper and lower guide flanges 9, is able to enter and travel along the said channels when fed forward by a driven shaft 10.

So that the paper strip may be fed forwards in a positive manner, the shaft 10 is provided, in the plane of each guide channel, with a peripheral system of radial teeth 11 which engage a corresponding system of perforations 11*a* formed in the paper strip 7 adjacent the upper and lower edges of the latter.

Drive is imparted to the shaft 10 by a constant speed electric motor and speed reduction unit 12 and the paper strip is held in contact with the shaft surface by a spring loaded pivoted pressure plate 13.

In front of the guide 1 and adjacent the said pressure plate, a scribe 14 is provided. The said scribe is reciprocated along a vertical path, in a known manner, by pressure sensitive or similar mechanism (not shown) housed within the casing of the instrument so that, as the paper strip 7 is fed forwards along the channels 5, 6 and between the guide and the scribe, the latter marks the exposed surface of the strip to record, in the form of a graph 15, the pressure or other variable factor, to be recorded.

At the end of the guide 1 opposite to the scribe and pressure plate, a bracket 16 is secured to and projects beyond the said guide in a plane parallel to the guide channels 5, 6. A tube or sleeve 17 which is fixed to the said bracket, projects upwardly from the latter, the axis of the tube being parallel to the axis of the driven shaft 10.

A spindle 18 (see Figure 4) extends through the tube and projects from the lower end of the tube, through and beyond the bracket 16, a grooved pulley 19 being made fast to its lower projecting end. The spindle also projects beyond the upper end of the tube 17 and a cam 20 is made fast to the spindle adjacent the upper projecting end of the latter and above the upper end of the tube. The said cam is shrouded by an inverted cup-like shell 21, through the crown of which the upper projecting spindle end passes. The shell is free to rotate about the spindle but is held against relative axial movement by a nut 18*a* screwed on to the upper extremity of the spindle.

As can be seen most clearly from Figures 5—9, the wall of the shell 21 is formed with a longitudinal slot 22 which extends between the open underside and crown of the said shell. The upper end of the slot registers with the outer end of a slot 23 in the shell crown; the crown slot 23 opens to the external periphery of the shell, and the inner portion 24 of one edge of the said slot, coincides with that portion 25 of the

internal shell surface which is immediately adjacent the wall slot 22.

The spindle 26 of the driven shaft 10 projects below the lower edge of the guide 1 and the projecting end of the said spindle has a grooved pulley 27, which is of a greater diameter than the pulley 19, secured thereto. An endless, extensible band 28 passes around the grooves of both the said pulleys so that drive is transmitted from the driven shaft 10 to the cam spindle 18. However, the tension in the band is such that the band can slip relatively to either pulley if any appreciable resistance is offered to the rotation of the cam spindle 18.

An angle-section plate 29 is located between the guide 1 and the tube 17. One flange of the said plate is provided, at each end of its upper and lower edges, with an ear 29*a* (see Figure 2) having a pivot pin 29*b* extending beyond the plate; the pins 29*b* are journalled in the guide flanges 9 and one of the said pins is loaded by a spring 30. The other flange of the plate 29 is located in the vicinity of and substantially parallel to the guide 1 and spans the gap between the said guide and the tube 17, the action of the spring 30 being such that it urges an edge of the said other flange into contact with the external surface of the shell wall. The said external wall surface is provided with two studs 31 which, as the shell rotates clockwise, as shown in Figures 2 and 5—9, impact the edge of the said other plate flange to hold the shell against further rotation. The said studs are located adjacent the wall slot 22 so that, when they are contacting the said plate edge, the latter is substantially in register with an edge of the wall slot and the corresponding edge of the crown slot 23.

The cross-sectional shape of the cam 20 is square except that the corners thereof are rounded (see Figures 5—9). Mid-way along the rounded edge at each corner of the cam, a shallow lobe 32 is provided. Each cam lobe also has a rounded edge and is of a depth such that a clearance exists between the said lobe edge and the internal surface of the shell wall.

It will be seen from Figure 2, that the strip of paper is unwound from the side of the roll on the spool 8 which is remote from the guide 1 so that when the strip is fed over the shaft 10 on to the front of the said guide, the natural curl of the strip (consequent to its being stored in roll form) tends to make its free edge curl towards the said guide and, when the said free strip edge travels beyond the guide, curls towards the angle-section plate 29 and, subsequently, towards the cam faces.

When the motor of the unit 12 is started, the shaft 10 and the pulley 27 are rotated at a constant and uniform speed. The rotation of the shaft drives the strip along the guide channels 5, 6 so that the leading edge of the strip rides along and in contact with the front of the guide towards the tube 17 and shell 21. At the same time, the pulley 27 rotates, through the endless band 28, the pulley 19, spindle 18 and cam 20; owing to the difference in the diameter of the pulleys 27 and 19, the spindle and cam turn through a considerably larger number of revolutions in a given time than the shaft 10. Since the shell is carried solely by the spindle 18, it follows that the shell tends to rotate with the spindle; in fact, if the shell is in the position shown in Figure 5 when the motor is started, the shell rotates with the cam until the studs 31 impact the angle-section plate 29 (see Figure 6) whereupon the shell comes to rest with its wall slot 22 and the mouth of its crown slot 23, positioned ready to receive the leading edge of the paper strip 7.

As the said strip edge travels beyond the guide, along the flange of the angle plate which bridges the space between the guide and shell, and then beyond the said flange, it is, as shown in Figure 6, guided directly into the wall slot 22 and along the crown slot 23. When the paper strip enters the latter slot, the natural curl of the paper causes (as previously stated) the said leading edge to contact the rotating cam 20. Consequently, immediately, or shortly after, the leading edge of the paper reaches the slot edge portion 24 it is, provided of course that the thickness of the paper is in excess of the dimension of the clearances between the curved edges of the lobes 32 and the internal surface of the shell wall, gripped between one of the said lobes and the said internal wall surface (see Figure 7). The gripping of the strip prevents further movement of the cam relatively to the shell so that, thereafter, the shell is constrained to rotate with the cam causing the studs 31 to displace the angle-section plate about its pivoted edge against the action of the spring 30, and to ride beyond the free edge of the said plate (see Figure 8). Since the paper is now gripped between the cam and the shell, and since the linear speed of the paper is determined by the peripheral speed of the shaft 10 which is less than the peripheral speed of the cam, the rotation of the cam and spindle is resisted by the tension in the paper; since slip may take place between the band 28 and one or both of the pulleys 19 and 27, the speed of rotation of the cam and spindle is reduced and the shaft 10 continues to rotate at the same constant and uniform speed.

As is clearly shown in Figure 9, shortly after the studs 31 ride beyond the angle-section plate 29, they are covered by the paper strip; therefore, there is no tendency

for the said studs to re-engage the free edge of the said plate at the end of the first or any subsequent revolution of the shell. Therefore, for so long as the motor in the unit 12 continues to rotate the shaft 10, the strip is re-wound around the shell at a speed determined by the rotational speed of the said shaft.

It will be seen from Figure 1, that the graph marked upon the paper strip by the scribe 14, is clearly visible across the entire distance between the scribe and the shell; therefore this distance may be exposed for inspection through a viewing aperture in the casing of the mechanism.

If, at any time, it is desired to inspect the graph marked upon a portion of the strip which has been re-wound around the shell, this may be done readily by gripping the strip portion between the guide and the shell and pulling on the strip in the reverse direction to that in which it is being driven by the shaft 10, whereupon the shell, cam and spindle are rotated in the reverse direction to that in which they were being driven by the band 28 again without affecting the speed of rotation of the shaft since the reverse movement of the spindle and its pulley 19 merely increases the degree of slip between the band and the said pulley and/or the pulley 27. Upon relieving the pull upon the strip, the latter will be re-wound automatically on to the shell since the latter will immediately commence to rotate with the cam and spindle at maximum speed until all slack in the strip has been removed.

As and when it is desired to remove the strip portion which has been re-wound upon the shell, the material may be severed, for example by cutting, at any position between the scribe and the opposite end of the guide, the re-wound strip is manually held against rotation, and the pulley 19 is manually rotated in the reverse direction to that in which it is driven by the band 28 thereby rotating the cam in the direction which terminates its grip on the leading edge of the strip. The re-wound portion may then be bodily withdrawn, endwise and upwardly, from the shell (as shown in Figure 3) or may be unwound from the shell by pulling on its severed end since the shell is, once again, free to rotate relatively to the cam.

The cam may be given various cross sectional shapes other than that shown in Figures 5—9 and one such alternative shape is shown in Figure 10. The cam 20*a* shown in Figure 10 is provided with three lobes 32*a* each having an arcuate working face 32*b* the space or clearance between which and the internal wall surface of the slotted shell, gradually increases from the periphery towards the centre of the cam. A cam of such a shape is particularly useful since it enables the same apparatus to be utilised for re-winding paper or other flexible material of widely different thicknesses.

Since the shell 21 is of inverted cup-shape and is, therefore, open at its underside, it is improbable that any dust or other foreign matter will enter and remain in the shell and choke the clearance between the cam lobes and the internal surface of the shell wall; in any event, the travel of the lobe faces around and in close proximity to the said wall surface, has a wiping or self-cleaning action which automatically dislodges any foreign matter that may gain access to the interior of the shell, whereupon such foreign matter falls through the open underside of the shell. As a consequence, there is little possibility of the shell becoming jammed to the rotating cam before the leading edge of the flexible material to be re-wound by the apparatus, is gripped.

If desired, the drive from the constant speed motor and speed reduction unit 12, may be transmitted to the cam spindle through a slipping clutch instead of through the endless band 28.

As previously stated, the apparatus may be applied for purposes other than re-winding paper in a recording instrument; for example, the apparatus may be utilised for re-winding film in a camera since, in such an appliance, the apparatus would enable the exposed portion of the film to be cut off and removed from the re-winding spool of the camera, leaving the unexposed film portion undisturbed. The apparatus would enable the leading end of the said unexposed portion to be gripped automatically when the camera is reassembled ready for further use, as the said end is fed through the camera by rotation of the film carrying spool which would replace, for example, the spool 8, instead of by rotation of the re-winding spool, as is usual.

What we claim is:—

1. Apparatus for winding flexible strip material into roll form, wherein a cam is fixed to a driven spindle within a cylindrical shell around which the material is to be wound, the said shell being mounted on but being rotatable relatively to the said spindle, and having a longitudinal slot in its periphery to enable the leading of the strip material to be fed into the shell and to be gripped between the internal surface of the shell and the external periphery of the cam, and resilient means being provided for holding the shell against rotation until after the said strip has been gripped between the shell and cam.

2. Apparatus as claimed in Claim 1 wherein the resilient means comprise a resilient abutment provided adjacent the shell and the latter is formed with an

external projection which is adapted to impact said abutment and prevent rotation of the shell prior to the entry of the material end into the said shell.

3. Apparatus as claimed in Claim 1 wherein the resilient means comprise a plate pivoted about an axis parallel to the spindle and so spring-loaded that an edge of the plate is spring driven into contact with the external wall of the shell; the said wall being provided with a projection at one edge of the longitudinal slot, so that by an initial rotary movement of the cam and spindle prior to the passing of the material into the shell through the said slot, rotary movement is imparted to the shell until the projection impacts the said plate edge and locates the slot in the plane of the plate thereby enabling the latter to guide the material end into and through the said slot.

4. Apparatus as claimed in Claim 1 wherein the spindle is rotatable through a drive transmission which includes slip means so that, after the material has entered the shell and has been gripped between the cam and internal shell surface, the speed at which the spindle, cam and shell are rotated does not exceed the speed at which the material is fed towards the shell, and so that the spindle may be stopped or rotated manually in the reverse direction whilst the drive transmission continues to operate.

5. Apparatus as claimed in Claim 4 wherein a grooved pulley is secured to the spindle and drive is transmitted to the said pulley by an endless band engaging the groove.

6. Apparatus as claimed in Claim 4 wherein a motor imparts drive to a drum over which the material passes and by which the said material is fed to the shell, the drum being rotated at a constant speed and imparting drive to the spindle through the drive transmission, the said transmission including speed increasing means so that after the material has been gripped the shell tends to rotate at a greater peripheral speed than that of the drum.

7. Apparatus as claimed in Claim 6 wherein the drum is provided with systems of radial teeth and the material is formed with corresponding systems of perforations which engage the said teeth so that the material is fed towards the shell by the drum in a positive manner.

8. Apparatus as claimed in Claim 1 wherein the shell consists of an inverted cup-like member which shrouds the cam so that any foreign matter which may gain access to the shell interior tends to fall through the open underside of the said shell.

9. Apparatus as claimed in Claim 8 wherein a slot is formed in the crown of the shell, the mouth of the said slot opening to one end of the longitudinal slot and the inner portion of one side thereof being flush with a corresponding portion of the internal shell surface so that when the end of the material enters the shell it is free to lie against the said surface portion.

10. Apparatus for winding a length of flexible strip material, constructed, arranged and adapted to operate substantially as herein described with reference to the accompanying drawings.

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PROVISIONAL SPECIFICATION.

Improvements in, or relating to, Apparatus for Winding Paper, or other similar Flexible Strip Material, into Roll Form.

We, WALKER CROSWELLER & COMPANY LIMITED, a British Company, of Whaddon Works, Clyde Crescent, Cheltenham, Gloucestershire, do hereby declare this invention to be described in the following statement:—

This invention has reference to apparatus for winding paper or other flexible strip material, into roll form; more particularly, the invention has reference to apparatus for embodiment in measuring instruments (such as fluid flow or pressure recording instruments) of the kind wherein a strip of paper is fed from a roll in one part of the instrument, across a viewing aperture, to another part of the instrument and, during its passage from the said one part to the other, is marked by a scribe which is displaced under the control of the instrument mechanism, the said apparatus being utilised for re-winding the marked paper.

The principal object of the present invention is to provide an automatic winding apparatus which is of compact dimensions, simple and robust in construction, efficient in operation, and adapted to operate over long periods without attention.

Further objects of the invention are to enable the paper or like material which is wound by the apparatus, to be unwound by hand for inspection or other purposes, and,

if desired, to be re-wound again; to enable a wound roll of paper or the like to be removed bodily from the apparatus; and, when the apparatus is embodied in a recording instrument, to enable a maximum length of marked paper to be visible through the viewing aperture.

In accordance with the said invention, a winding apparatus comprises a rotatable cam which is housed within a cylindrical shell having, in and between the opposite ends of its side wall, a slot which opens into the interior of the shell and which is adapted to receive the leading end of the material to be wound, the minimum clearance between the cam and the internal surface of the shell, in the vicinity of the slot, being less than the thickness of the said material, and resilient means being provided to prevent rotation of the shell until the said leading end enters the said clearance.

Preferably the slot opens into the shell interior tangentially to the internal periphery of the shell so that the leading end of the material is guided automatically into the clearance between the cam and shell, and the cam is formed with a plurality of lobes spaced apart around its periphery so that the said minimum clearance is created and the material end is gripped between the cam and shell, as soon as possible after the said end enters the slot.

To render the apparatus suitable for winding materials of varying thickness, the gripping faces of the cam lobes may be inclined relatively to the internal periphery of the shell, to provide clearances which vary in width, the clearance of greater width being provided at the leading edges of the said lobe faces.

The cam may be secured to a driven spindle which extends freely through an upwardly extending tube having an external diameter less than the internal diameter of the shell, and the underside of the cam may be rotatably supported upon the said tube. Also, the spindle may project beyond the upper face of the cam and serve as a support for a tubular extension from the top of the shell, means being provided for preventing axial movement of the shell upon the spindle, for example, when a wound roll of material is withdrawn endwise from and upwardly of the shell.

To prevent rotation of the shell, in spite of its tendency to do so due to the rotation of the spindle and cam, until the leading end of the material to be wound has entered the clearance and has been gripped between the cam and shell, the latter may be provided with an external projection which abuts the end of a spring loaded lever, the loading of the lever being such that the lever is rocked automatically away from the shell projection by the increased torsional force applied to the shell by the rotating cam acting through the gripped end of the material. The lever may consist of a pivoted plate which guides the said end of the material into the mouth of the slot in the shell.

In a typical application of the invention to a recording instrument in which a strip of paper is fed horizontally across a fixed guide incorporated in the instrument behind the viewing aperture, a bracket is provided on the end of the guide towards which the paper is being fed. The tube through which the driven spindle extends is mounted vertically upon the bracket, and the latter is provided with an aperture in register with the bore of the tube so that the spindle may depend through the bracket and be provided at its lower end with a pulley to enable drive to be transmitted to the spindle.

The drive is transmitted to the spindle from a constant speed motor located at the opposite end of the guide, through a tensioned endless band or a slipping clutch, in a manner such that the spindle speed tends to exceed the speed of the motor spindle but may be reduced as and when desired, for example, by hand or due to the drag of the paper when the latter is gripped between the cam and the shell.

The shell is of inverted thimble shape and its slot for receiving the leading end of the paper, opens into the interior of the shell tangentially to the internal periphery of the latter. The slot extends across the top of the shell for a substantial distance to enable the leading end of the paper to pass through the slot to a corresponding distance within the shell. The tubular extension from the top of the shell, is located coaxially to the spindle and the latter passes through and beyond the upper end of the said extension. Lock nuts are engaged with the upper end of the spindle to prevent or limit axial movement of the shell relatively to the spindle.

The external projection on the shell periphery consists of a bead which is located parallel to the mouth of the slot and on the side of the latter which is located behind the paper after the leading paper end has entered the slot.

A plate, of a depth substantially equal to that of the fixed paper guide, is located between the said guide and the shell. The plate is hinged by one edge about the fixed guide or upon any other convenient support within the instrument and is loaded by a light spring which tends to swing its opposite edge into contact with the external periphery of the shell and into the path of the bead when the shell is being rotated. If desired, or necessary, a lip may be provided on the said shell-contacting plate edge for engagement with the bead.

When the instrument is in operation the

motor rotates continuously at a constant speed so as to feed the paper across the fixed guide, also at a constant speed. Since the motor drives the cam spindle, the latter is also rotated continuously within its supporting tube and, due to the fact that the shell extension surrounds the upper part of the spindle, there is a tendency also for the shell to rotate with the spindle thus bringing the bead on the outside of the shell into contact with the edge of the spring loaded pivoted plate; this engagement prevents rotation of the shell and, therefore, the cam rotates continuously within the latter.

As the leading end of the paper passes beyond the end of the fixed guide it travels along the surface of the pivoted plate and is constrained by the latter to enter the mouth of the slot in the shell and then to pass into the clearance between the cam and the internal periphery of the shell. Almost immediately the said leading end enters the said clearance, one of the four cam lobes impacts the back of the paper and, therefore, due to the small clearance which exists between the said lobe and the internal periphery of the shell, the leading end of the paper is gripped securely between the cam and the shell. Thereafter the cam and shell rotate in unison and the resulting additional torsional force applied to the shell by the rotating cam and spindle, forces the bead out of engagement with the edge of the spring loaded plate.

Since the paper is being fed forwardly at a controlled speed, it applies a drag upon the cam and, therefore, the speed of rotation of the latter and its spindle is determined by the speed at which the paper is fed across the fixed guide.

The continued rotation of the cam and spindle in unison causes the leading end of the paper to be wrapped around the outside of the shell in roll form. Obviously the first coil of paper applied around the shell covers the bead so that there is no tendency for the latter to engage the edge of the pivoted plate at the end of each complete revolution of the shell.

If it is desired, for any reason, to inspect the paper rolled upon the shell, it is only necessary to pull upon the paper when the shell, cam and spindle are rotated in the reverse direction, which reversal of travel is permitted by the drive transmitting tensioned band or the slipping clutch. The unrolling of the paper removes the drag from the cam and spindle so that, immediately the paper is released, the shell, cam and spindle rotate at a greater speed than the motor spindle and, therefore, the paper is gradually re-wound upon the shell. However if, after unwinding the paper it is desired to disengage the leading end of the paper, it is only necessary for a manual torsional force to be applied to the spindle in opposition to the drive imparted thereto whereupon the abutting cam lobe is taken out of contact with the back of the paper, and the latter is released.

Similarly, if it is desired to withdraw the rolled paper from the cylinder without previously unwinding the paper, the said manual force is again applied to the spindle after severing the wound portion from the remainder of the paper (for example, by cutting same with a knife) whereupon the said wound paper may be withdrawn upwardly over and out of engagement with the shell.

Since the paper is fed from a roll carried in the instrument at the opposite end of the fixed guide to the winding apparatus described above, it is desirable that the cam spindle should be rotated in the direction which rewinds the paper in the same direction as that in which it was originally wound so that the natural curl of the paper facilitates the entry of its leading end into the shell slot.

Since the shell is of inverted thimble form it is improbable that any dust or similar foreign matter will enter the shell and choke the clearance between the cam lobes and the shell periphery; in any event, the travel of the gripping lobe faces around and in close proximity to the internal surface of the shell, has a wiping or self-cleaning action which automatically dislodges any foreign matter that may enter the shell whereupon such foreign matter falls through the open bottom of the shell. As a consequence, there is little possibility of the shell becoming jammed to the rotating cam before the leading end of the paper is gripped.

Since the shell and any paper wound thereon is located wholly to one side of the fixed guide and pivoted spring loaded plate, the whole of the paper extending across the said guide and plate may be seen through the viewing aperture of the instrument so that a maximum ink marking on the paper is constantly visible.

It is to be understood that the shape of the cam and internal periphery of the shell may be varied from that described above provided that the minimum clearance between each lobe and the shell is less than the thickness of the material to be gripped. Also, the winding apparatus may be applied for purposes other than re-winding paper in a recording instrument; for example, the apparatus may be utilised for re-winding film in a camera since, in such an appliance, the apparatus would enable the exposed portion of the film to be cut off and removed from the re-winding spool of the camera, leaving the unexposed film portion undisturbed. The apparatus would automatically pick up the leading end

of the said unexposed portion when the camera is reassembled ready for further use, as the said end is fed through the camera by manual rotation of the film carrying spool instead of, as is usual, by rotation of the rewinding spool.

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Published at The Patent Office, 25, Southampton Buildings, London, W.C.2,
from which copies may be obtained.

716,109 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

FIG.1.

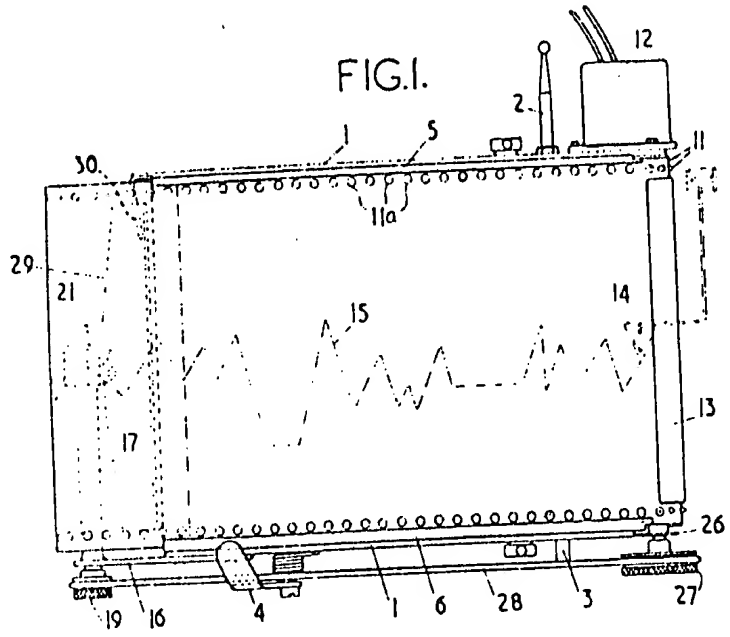

FIG.2.

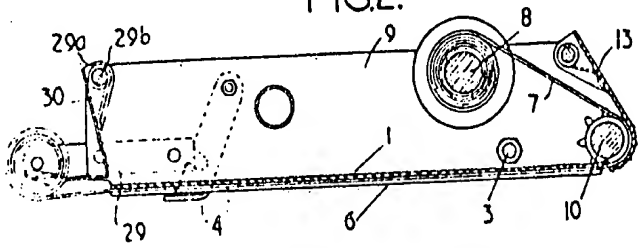

FIG.3.

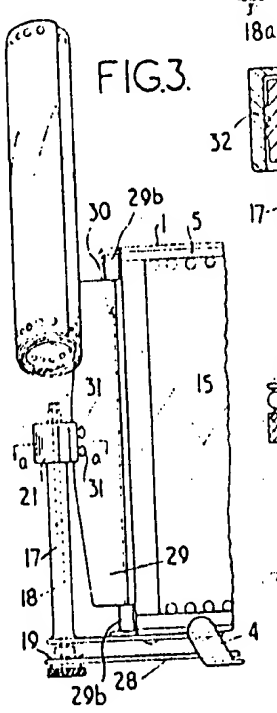

FIG.4.

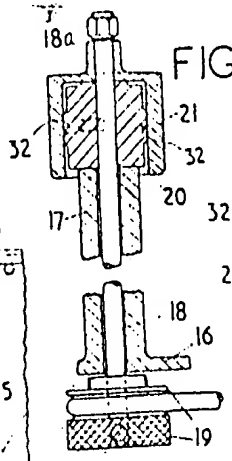

FIG.5.

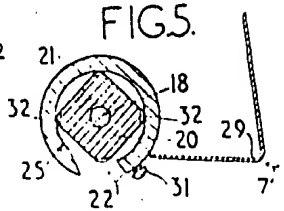

FIG.6.

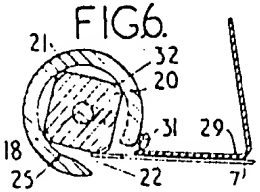

FIG.7.

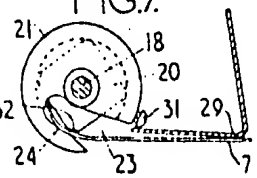

FIG.8.

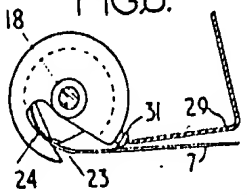

FIG.9.

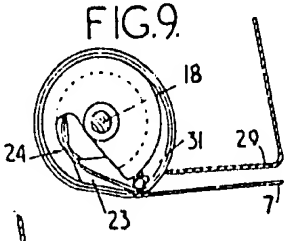

FIG.10.